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"Efficiency - Equity - Clarity"

Pavement Busters Guide

Why and How to Reduce the Amount of Land Paved for Roads and Parking Facilities

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1. Abstract

This guide describes ways to reduce the amount of land required for roads and parking facilities. It examines factors that result in overgenerous road and parking capacity standards. It summarizes various costs of paving land for roads and parking facilities, including the opportunity costs of land, direct financial costs, a number of environmental impacts, reduced housing affordability, and increased automobile dependency. Due to these costs, society would benefit from marginal reductions in road and parking, provided that mobility and access are not severely reduced. A number of strategies are described for reducing parking requirements.

"*Form no longer follows function, fashion, or even finance; instead, form follows parking requirements.*" Donald Shoup[1]

[1] Donald Shoup, "Cashing Out Employer-Paid Parking," *Journal of the American Planning Asso.*, 1994.

Introduction
Road and parking facilities provide benefits. But devoting too much land to roads and parking wastes resources and degrades the environment. Current practices often result in excessive road and parking capacity. As a result, more of the landscape is paved than is optimal. This paper examines why this occurs, describes problems that result, and recommends better practices. It describes specific strategies to reduce road and parking requirements without reducing access to goods, services and activities.

How Current Practices Oversupply Road Space and Parking
A number of current practices contribute to oversupply of parking and road capacity.

Most communities have minimal road and parking standards based on demand studies published by professional organizations such as the Institute of Transportation Engineers (ITE).[2] Table 1 illustrates an example of such standards.

Table 1 **Typical Zoning Requirements for Off-Street Parking**[3]

Building Type	Unit	Spaces
Single Family Housing	Dwelling Unit	2.0
Multi-Family Housing	Dwelling Unit	1.8
Apartments	Dwelling Unit	1.5
Neighborhood Commercial	100 sq. m. GLA	4.7
Community Commercial	100 sq. m. GLA	5.3
Regional Commercial	100 sq. m. GLA	5.8
Office Building	100 sq. m. GFA	3.2
Fast-Food Restaurant	Seats	0.85
Church	Seats	0.5
Hospital	Beds	2.6
Light Industry	100 sq. m. GFA	2.2

GLA = Gross Leasable Area GFA = Gross Floor Area

This table illustrates typical recommended parking requirements.

Although these standards are assumed to be accurate and rational, they are actually quite arbitrary, based on highly scattered data. For example, demand studies for "General Office Building" show a range from 0.81 to 5.76 parking spaces occupied per 100 square meters of gross building area, a 1:7 ratio between the lowest and highest rate.[4] For buildings of 300 sq. metres, the number of parking spaces occupied ranged from less than 600 to more than 1,000. Similar ranges exist for most other building types and sizes. Standards based on averaging the values from such studies result in excessive parking for some buildings and insufficient parking for others. As Donald Shoup describes:

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[2] *Highway Capacity Manual*, and *Parking Generation*, ITE (Washington DC; www.ite.org), 1994.

[3] Homburger, Kell and Perkins, *Fundamentals of Traffic Engineering*, Institute of Transportation Studies, UCB (Berkeley), 1992, p. 27-2; *Local Government Parking Policy*, WSDOT, Commute Trip Reduction Program (www.wsdot.wa.gov/pubtran/ctr).

[4] *Parking Generation, 2nd Ed*, Institute of Transportation Engineers (Washington DC; www.ite.org), 1987.

> Parking requirements in the planning profession today resemble bloodletting in the medical profession until the end of the last century. For more than two thousand years physicians prescribed bloodletting to cure many diseases. Medical textbooks contained elaborate tables stating exactly how much blood to let for each disease, just as zoning ordinances now contain elaborate tables stating exactly how many parking spaces are required for each land use.[5]

At least three factors significantly affect parking demand:

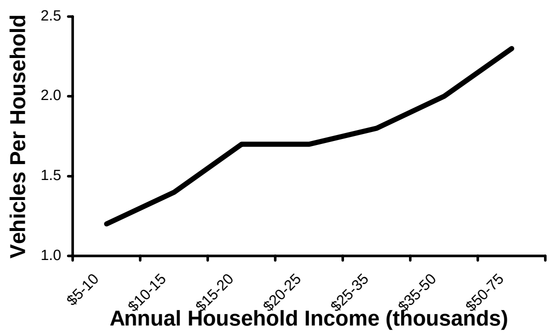
1. *Pricing.* Demand decreases as prices increase. Table 2 shows typical reductions in vehicle commute trips (and therefore parking demand) at worksites resulting from parking charges.

Table 2 **Commute Trip Reductions from Daily Parking Charges**[6]

	$1	**$2**	**$3**	**$4**
Suburb	6.5%	15.1%	25.3%	36.1%
Suburban Center	12.3%	25.1%	37.0%	46.8%
Central Business District	17.5%	31.8%	42.6%	50.0%

2. *Demographics.* Vehicle ownership and use are affected by income and lifecycle stage. Figure 1 illustrates how the average number of vehicles per household is affected by income.

Figure 1 **Vehicle Ownership by Income Class**[7]



Vehicle ownership tends to increase with income. Residential parking requirements based on overall average ownership rates are excessive for lower income housing.

Geography. *Vehicle ownership and use tends to decrease as density, transit service and non-motorized travel (walking and bicycling) increase. Figure 2 shows significant differences in per-capita trip rates between suburban and traditional neighborhoods.*

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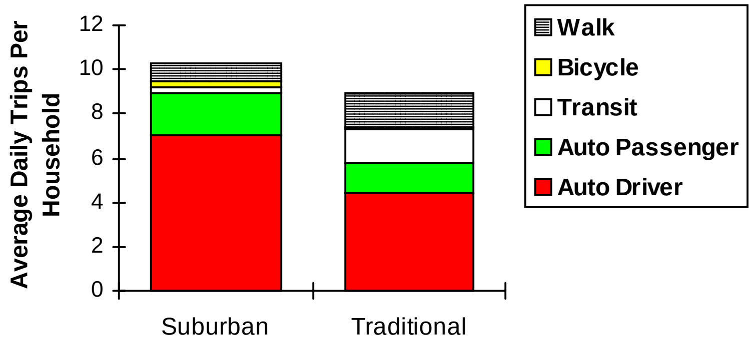
5 Donald Shoup, "The High Cost of Free Parking," *Journal of Planning Education and Research*, Vol. 17, No. 1, September 1997.

6 Philip Winters and Daniel Rudge, *Commute Alternatives Educational Outreach*, National Urban Transit Institute, Center for Urban Transportation Research (Tampa; www.cutr.eng.usf.edu), 1995, Table 3.3-8.

7 *Household Vehicle Energy Consumption 1994*, USDOE (www.eia.doe.gov/emeu/rtecs), 1994, Table 1.1.

Figure 2 **Average Daily Trips Per Household by Neighborhood Type**[8]



Vehicle trips per household are significantly higher in suburban communities due to lower densities and fewer travel choices. Standards based on demand studies performed in suburbs tend to oversupply roads and parking in traditional neighborhoods.

ITE parking studies, and the minimum requirements based on them, generally ignore these factors. They include no adjustments for pricing, for lower income users, or for locations that are more accessible by transit, bicycling and walking. As a result, they do not accurately represent parking demand at a particular site.[9]

For several reasons published road and parking standards tend to be excessive, resulting in more pavement than necessary to accommodate mobility needs.[10] First, most study sites have free parking. The result is equivalent to predicting the number of meals a restaurant can give away for free. Basing parking requirements on demand studies at zero price results in a self-fulfilling prophesy: standards are so generous it would be uneconomical to charge for parking since most spaces would be unused if priced.

Most published demand studies are performed at relatively isolated sites, since it is difficult to attribute shared parking to a particular building. For example, if a barber shop, grocery store and theater share parking facilities it would be difficult to determine which vehicles are attracted by which business. As a result, suburban, automobile dependent sites are overrepresented, resulting in standards that are excessive for urban conditions, areas with multi-modal transportation, or where roads and parking are not free.

Other practices also encourage excessive road and parking capacity. Parking facilities tend to be taxed at a lower rate than if the same land were devoted to buildings. Federal tax laws favor parking as an employee benefit. Most employers provide free employee parking, but don't bother to offer an equivalent benefit to employees who use other

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[8] Bruce Friedman, Stephen Gordon, John Peers, "Effect of Neotraditional Neighborhood Design on Travel Characteristics," *Transportation Research Record, #1466*, 1995, pp. 63-70.
[9] Donald Shoup, "The Trouble With Minimum Parking Requirements," *Transportation Research A*, Vol. 33, No. 7/8, Sept./Nov. 1999, pp. 549-574, also available at VTPI (www.vtpi.org).
[10] *Local Government Parking Policy and Commute Trip Reduction; 1999 Review*, Commute Trip Reduction Office, WSDOT (Olympia, www.wsdot.wa.gov/pubtran/ctr), 1999.

modes. Free or underpriced parking is often offered by businesses and municipal governments as a way to attract customers to commercial centers.

Transportation planners tend to assume that their primary goal is to accommodate motor vehicle travel. Any capacity increase is described as an "improvement," although from other perspectives (pedestrians, residents, the environment) it causes degradation (see box on the next page). Traffic engineers often use an "85th Percentile" standard when setting standards, which means that 85 out of 100 sites will have excess capacity even during peak-periods. Standards tend to be applied with little flexibility – considerable paperwork and a heavy burden of proof are usually required for variances. Although public service costs are higher for lower-density, urban fringe development, this is not usually reflected in taxes and fees.[11] Households in older urban neighborhoods tend to overpay for public services, while those in newer, lower-density suburban locations tend to underpay.[12] This encourages lower-density development.

As a result of these various factors, facilities tend to be underused. One study of worksites found that average parking supply was 30% greater than peak-period demand.[13] The average parking occupancy rate at commercial sites in one Midwest City was only 36%, and even during the annual peak only 74% of parking spaces were used at retail sites.[14] Other studies find similar levels of oversupply.[15] Similarly, there are often opportunities to reduce the number and width of traffic lanes to improve mobility and safety.[16]

Generous standards are often defended as being "conservative," with the implication that they are cautious and efficient. But excessive standards are not conservative at all. A truly conservative policy encourages efficient resource use. Communities that apply alternative standards find that significantly less pavement can meet transportation needs.[17] For example, planners in Eugene, Oregon found that local road rights-of-way could be easily reduced 16-20% over standard practices without reducing performance.[18]

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[11] James Frank, *The Costs of Alternative Development Patterns*, Urban Land Institute (www.udi.org), 1989; Todd Litman, *Land Use Impact Costs of Transportation*, VTPI (www.vtpi.org), 1999.

[12] Subhrait Guhathakurta, "Who Pays for Growth in the City of Phoenix? An Equity-Based Perspective on Suburbanization," *Urban Affairs Review*, Vol. 33, No. 5 (www.urbanfutures.org/j102898.html), July 1998, pp. 813-838.

[13] Eileen Kadesh and Jay Peterson, "Parking Utilization at Work Sites in King and South Snohomish Counties, Washington," *Transportation Research Record 1459*, 1996, pp. 58.

[14] John Shaw, *Planning For Parking*, Public Policy Center, University of Iowa (Iowa City), 1997, p. 20.

[15] Richard Willson, "Suburban Parking Requirements; A Tacit Policy for Automobile Use and Sprawl," *Journal of the American Planning Association*, Vol. 61, No. 1, Winter 1995, pp. 29-42.

[16] Dan Burden & Peter Lagerwey, *Road Diets; Fixing the Big Roads*, Walkable Communities (www.walkable.org), 1999.

[17] Wolfgang Homberger, et al, *Residential Street Design and Traffic Control*, Institute of Transportation Engineers/Prentice Hall (Englewood Cliffs), 1989.

[18] Jim West and Allen Lowe, "Integration of Transportation and Land Use Planning Through Residential Street Design," *ITE Journal*, August 1997, pp. 48-51.

Developing Objective Transportation Language[19]

Many transportation planning terms are unintentionally biased toward motor vehicle travel. For example, projects that increase road or parking capacity are often called "improvements," although they may be harmful to many activities and people. Wider roads and larger parking facilities can degrade the local environment and reduce adjacent residential property values. Projects that increase vehicle traffic volumes and speeds can reduce the safety and mobility of pedestrians and cyclists. Calling such changes "improvements" indicates a bias in favor of one activity and group over others. Objective language uses more specific and neutral terms, such as "added capacity," "additional lanes," "modifications," or "changes."

The terms "traffic" and "trip" often refer only to motor vehicle travel. Short trips, non-motorized trips, travel by children, and non-commute trips are often undercounted or ignored in transport surveys, models, and analysis. Although most automobile and transit trips begin and end with a pedestrian or cycling link, they are usually classified simply as "auto" or "transit" trips.

The term "efficient" is frequently used to mean increased vehicle traffic speeds. This assumes that increasing motor vehicles speeds increases overall efficiency. This assumption is debatable. High vehicle speeds can reduce total traffic capacity, increase resource consumption, increase costs, and increase automobile dependency, reducing overall economic efficiency.

Level of service (LOS) is a qualitative measure describing operational conditions for a particular user group (motorists, cyclists, pedestrians, etc.). Transportation professionals often assume that, unless specified otherwise, level of service applies only to motor vehicles. It is important to indicate which users are considered when level of service values are reported.

Biased Terms	**Objective Terms**
Traffic	Motor vehicle traffic, pedestrian/bike traffic
Trips	Motor vehicle trips, person trips
Improve	Change, modify, expand, widen
Enhance	Change, increase traffic speeds
Deteriorate	Change, reduce traffic speeds
Upgrade	Change, expand, widen, replace
Efficient	Faster, increased vehicle capacity
Level of service	Level of service for…

Examples:

Biased: *Level of service* at this intersection is rated "D." The proposed *improvement* will cost $100,000. This *upgrade* will make our transportation system more *efficient* by *enhancing* capacity, preventing *deterioration* of *traffic* conditions.

Objective: *Level of service* at this intersection is rated "D" *for motorists* and "E" *for pedestrians*. A *right turn channel* would cost $100,000. This *road widening project* will *increase motor vehicle traffic speeds and capacity* but may *reduce safety and convenience to pedestrian travel*.

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[19] Inspired by "Transportation Language Policy" memo by West Palm Beach, Florida City Manager Michael Wright sent to transportation staff, 14 November 1996.

Reasons of Excessive Road and Parking Capacity

In fairness to transportation decision makers it is important to recognize that they have reasons to favor generous road and parking requirements which appear legitimate from their perspective. Transportation planners are primarily concerned with traffic movement, parking spillover problems, regulatory simplicity, and fiscal impacts.[20] Abundant road and parking capacity therefore appears to satisfy their professional mandate.

Wide roads and abundant parking facilitate motor vehicle use. Wide roads can help prevent traffic congestion and delays to emergency vehicles. Convenient parking is important to businesses.

A shortage of parking leads to conflicts, such as illegal parking, and commercial parking spilling over onto residential streets. Parking regulations, metered parking, and parking enforcement are politically unpopular. Such problems can be avoided by simply forcing developers to supply abundant off-street parking. This may appear equitable, since businesses will simply pass such costs onto their customers.

From an administrative perspective it seems easiest and fairest to apply a single standard, rather than using more flexible policies that may be challenged. Negotiating exceptions and processing variances requires agency staff time. Although professional organizations provide recommended minimal parking requirements, there are fewer resources for developing flexible standards.

Parking requirements imposes no direct cost on government budgets. Increasing such requirements is far cheaper than providing public parking facilities.

Automobile ownership and use have grown steadily over the last century. Since parking facilities tend to be difficult to expand in the future, it may seem sensible to always err on the side of oversupply, in order to accommodate possible increases in future demand.

Planning institutions and professional practices tend to define specific areas of responsibility. Impacts outside of these boundaries are considered somebody else's problem. Transportation professionals may be unfamiliar with many of the costs associated with excessive parking requirements.

All of these factors help explain why planning institutions tend to favor excessive road and parking capacity. However, virtually all of these issues can be addressed with strategies that encourage more efficient land use and transportation patterns described later in this report.

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[20] Richard Willson, *Reading Between the Regulations; Planners Perspectives on Minimum Parking Requirements*, Transportation Research Board Annual Meeting (www.nas.edu/trb), January 1999.

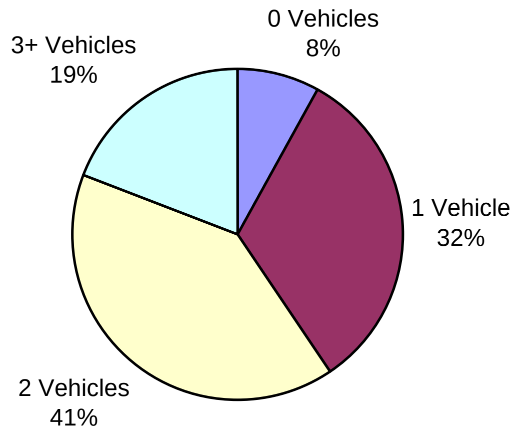
The Full Costs of Roads and Parking

Overly generous roadway and parking requirements impose a number of costs on society.

Parking is expensive. More expensive than most people realize. Few consumers purchase a parking space as an independent item. Instead, parking is incorporated into the costs of buildings and roadway facilities, and added as a hidden surcharge to the price of virtually any good or service that we buy. Consumers pay for parking facilities through higher rents (for residential parking), lower wages and benefits (for employee parking), higher taxes (for roads and government funded parking facilities), higher prices for retail goods (for commercial parking), and environmental degradation. According to one estimate, the total value of parking facilities exceeds the total value of motor vehicles.[21] This implies that each automobile purchase burdens society with equal or greater parking costs.

Parking requirements violate a basic principle of economic efficiency by forcing consumers to pay for a good regardless of whether they want it. By charging indirectly rather than directly for these facilities, consumers forego an opportunity to save money by reducing their vehicle use. This is also unfair. Some people must pay for parking they don't use, while others use parking spaces they don't pay for. Figure 3 illustrates vehicle ownership by households. A requirement that each residence must have two parking spaces meets the needs of 41% of households, but require excessive parking spaces for 40%, and provide too few parking spaces for 19%. Since lower income and elderly households tend to own fewer automobiles, they are the ones that most frequently are forced to pay for parking they don't need.

Figure 3 **Vehicle Ownership Per Household**[22]



This figure shows the distribution of vehicle ownership per household.

Paving land to provide overly generous road and parking capacity imposes a number of economic and environmental costs on society, described below.

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[21] Donald Shoup, "The Trouble With Minimum Parking Requirements," *Transportation Research A*, Vol. 33, No. 7/8, Sept./Nov. 1999, pp. 549-574, also available at VTPI (www.vtpi.org).

[22] National Personal Transportation Survey (www-cta.ornl.gov/npts), 1995.

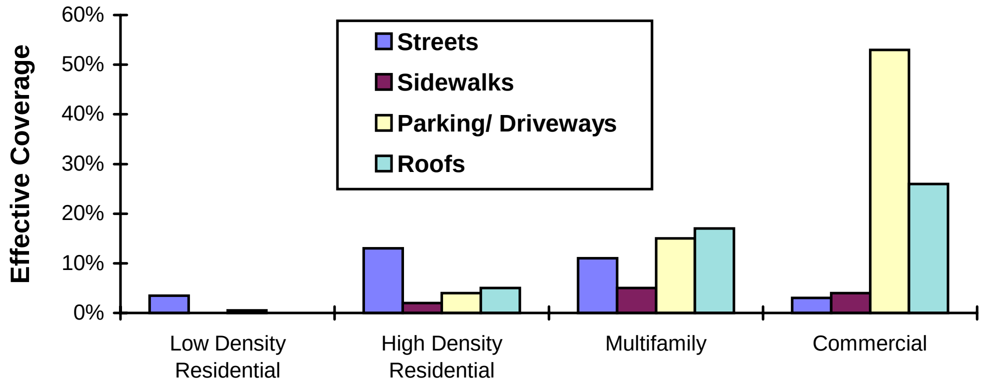
1. Land

Virtually all land paved for roads and parking facilities has an opportunity cost. Road rights-of-way and publicly owned off-street parking probably represent the most valuable single asset owned by most governments. Each increase in the amount of land used for these purposes represents a cost in terms of less land available for other productive uses. Although some jurisdictions can expand, so an acre devoted to roads and parking can be offset by an additional acre added to the community, many jurisdictions are physically constrained, so more land for roads and parking means a smaller tax base.

Parking spaces are typically 8-10 feet wide and 18-20 feet deep, totaling 144 to 200 square feet. This is approximately doubled to 300+ square feet per space when access lanes are included, allowing about 125 spaces per acre.[23]

The amount of land devoted to roads and parking varies depending on land use patterns. Pedestrian-oriented cities typically devote less than 10% of land to transportation, while automobile-oriented cities devote up to three times as much.[24] Figure 3 illustrates the portion of land devoted to roads and parking for four types of land uses. Although lower density areas may devote relatively less land to roads and parking, the amount paved per capita tends to be high. A certain amount of road capacity is needed to provide "basic access," but the larger amounts of roadway land needed per capita for an automobile-oriented transportation system can be considered a subsidy to driving.

Figure 3 **Impervious Surface Coverage of Different Land Use Classes**[25]



Roads, parking facilities, sidewalks and the development that they bring to an area displace and damage natural greenspace. Although low-density residential development may have less percentage impervious surface, coverage per capita may be greater.

[23] James Hunnicutt, "Parking, Loading, and Terminal Facilities," in *Transportation and Traffic Engineering Handbook*, Institute of Transportation Engineering/Prentice Hall, 1982, p. 651.
[24] Harry Dimitriou, *Urban Transport Planning*, Routledge, (NY), 1993, p. 136.
[25] *Impervious Surface Reduction Study*, City of Olympia Public Works (Olympia), May 1995, p. 39.

2. Construction and Maintenance Costs

Road construction and maintenance is a major municipal expense in most communities. Roadway expenditures average $264 per capita in U.S. cities, or nearly 1% of gross regional product.[26] Construction costs (excluding land) average about $1,600 per space for surface parking, $10,000 or more per space for structured parking, and $20,000 or more per space for underground parking.[27] Annual maintenance costs range from about $20 to $100 per year.[28] Total annual operating costs average $200 to $700 per space, requiring monthly revenue ranging from $42 to $196 per space to break even.[29]

Providing minimum parking requirements is estimated to cost an average of $31 or more per square foot of developed building floor area in typical U.S. cities, 4.4 times larger than all other impact fees combined.[30] In other words, the cost to developers of municipal services such as water, sewage, schools and roads are dwarfed by the financial burden that governments impose by requiring generous parking capacity.

The table below illustrates the estimated financial costs of parking facilities under various conditions.

Table 3 **Typical Parking Facility Costs**

	Land Per Acre	**Land** Per Space	**Construction**	**Annual O&M**	**Annual Cost**	**Monthly Cost**	**Daily Cost**
Suburban, Surface	$250,000	$2,000	$1,600	$20	$329	$27	$0.91
Suburban, 3-Story Struct.	$250,000	$667	$10,000	$50	$965	$80	$2.68
Suburban, Underground	$250,000	$0	$20,000	$100	$1,816	$151	$5.05
Urban, Surface	$1,000,000	$8,000	$1,600	$20	$844	$70	$2.34
Urban, 5-Story Struct.	$1,000,000	$1,600	$10,000	$50	$1,045	$87	$2.90
Urban, Underground	$1,000,000	$0	$20,000	$100	$1,816	$151	$5.05

Assuming 25 year loans at 7% interest.

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[26] Jeff Kenworthy, Felix Laube, Peter Newman and Paul Barter, *Indicators of Transport Efficiency in 37 Global Cities*, Sustainable Transport Research Group, Institute for Science and Technology Policy, Murdoch University (Perth, Australia), A Report for the World Bank, February, 1997.

[27] James Hunnicutt, "Parking, Loading, and Terminal Facilities," in *Transportation and Traffic Engineering Handbook*, Institute of Transportation Engineering/Prentice Hall, 1982, p. 651.

[28] Wegmann, *Cost-Effectiveness of Private Employer Ridesharing Programs, An Employer's Assessment*, Transportation Center, University of Tennessee, 1985.

[29] John Dorsett, "The Price Tag of Parking," *Urban Land*, May 1998, pp. 66-70.

[30] Donald C. Shoup, "In Lieu of Required Parking," *Journal of Planning Education and Research*, Vol. 18, 1999, pp. 307-320; Donald Shoup, "Instead of Free Parking, *Access 15* (http://socrates.berkeley.edu/~uctc), Fall 1999, pp 8-13.

3. Lower Density Land Use and Urban Sprawl

Generous road and parking standards increase the land needed for a given amount of development. For example, increasing parking requirements from one to two spaces per unit increases the land required for a three-story multi-family housing by about 33%. This shifts development to the urban periphery where land costs are lower.[31]

4. Environmental and Aesthetic Impacts

Paving land imposes a number of environmental costs, including increased stormwater management costs and loss of greenspace.[32] Undeveloped land, farmland and urban landscaping (greenspace) provide a variety of environmental and aesthetic benefits, both to the land's owners and to society in general.[33] Greenspace provides habitat to wildlife, allows stormwater to percolate into the soil, provides privacy and noise reduction, reduces ambient temperatures, and improves air quality. Excessive pavement tends to reduce adjacent property values (few residents want a view overlooking a large parking lot), increase water pollution and stormwater flooding, and reduce privacy.[34]

If just 5% of a watershed is covered with impervious surfaces, such as roads and parking, surface water quality is seriously degraded.[35] Paved surfaces have a "heat island" effect (increased local temperatures).[36] Recent research indicates that urban areas are 2-8° F hotter in summer due to increased solar gain from dark colored roads, parking lots and building roofs, which increases energy demand, smog and human discomfort.[37]

Research by the Center for Watershed Protection finds that various watershed enhancement strategies that protect greenspace and reduce impervious surfaces tend to be cost effective due to reduced stormwater management costs and increased property values.[38] They cite a number of studies indicating that preserving trees, streams and shorelines increases nearby property values, and that cluster development is more cost effective to developers and communities, leading to a net increase in tax revenue.

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[31] Richard Willson, "Suburban Parking Requirements," *Journal of the American Planning Association*, Vol. 61, No. 1, Winter 1995, pp. 29-42.

[32] *Toward a Sustainable Future*, Transportation Research Board (Washington DC; (www.nas.edu/trb) Special Report 251, 1997, p. 4-8; Chester Arnold and James Gibbons, "Impervious Surface Coverage: The Emergence of a Key Environmental Indicator," *Am. Planning Association Journal*, Vol. 62, No. 2, Spring 1996, pp. 243-258; *Indicators of the Environmental Impacts of Transportation*, Office of Policy and Planning, USEPA (Washington DC; http://itre.ncsu.edu/cte), 1999; NEMO project (www.canr.uconn.edu/ces/nemo); Center for Watershed Protection (www.cwp.org).

[33] Todd Litman, *Land Use Impacts of Transportation*, VTPI (www.vtpi.org), 1999.

[34] Anton C. Nelessen, *Visions for a New American Dream*, Planners Press (www.planning.org), 1994.

[35] Richard Horner, Derek Booth, Amanda Azous, and Christopher May, "Watershed Determinates of Ecosystem Functioning," *Effects of Watershed Development and Management on Aquatic Ecosystems*, L.A. Roesner Ed., American Society of Civil Engineers (New York), 1996.

[36] Frederick Stutz, "Environmental Impacts," *Geography of Urban Transportation*, Susan Hanson, Ed., Guilford (New York), 1995, p. 391.

[37] *Cooling Our Communities*, USEPA (Washington DC), GPO#055-000-00371-8, Jan. 1992.

[38] Tom Schueler, *The Economics of Watershed Protection*, CWP (www.cwp.org) 1999.

5. Reduced Housing Affordability[39]

Increased parking requirements can significantly affect affordable housing. These requirements tend to have little impact on middle- and upper-income households, which usually own multiple vehicles and would demand two or more parking spaces per housing unit regardless of zoning standards, but they have significant impacts on the supply of affordable housing for lower-income households. Because parking costs are relatively fixed, they represent a greater cost to lower-price housing than to higher-price housing.

For example, requiring one space per housing unit increases the cost of a basic multi-family unit by 15%, and two spaces increases costs by 30%.[40] As a result, developers have less incentive to produce lower-price housing, and the availability of affordable housing declines. This is particularly inequitable because lower-income households tend to own fewer automobiles. As a result, poor families who own zero or one vehicle often subsidize the parking costs of their wealthier neighbors who own multiple vehicles.

6. Increased Curb Cuts

Curb cuts required for off-street parking impose two specific costs. They cause vehicles to cross sidewalks which degrades the pedestrian environment (and therefore the retail environment in commercial areas), and they reduce on-street parking capacity. A typical curb cut uses almost the same amount of curb space as a parked car, so a single-vehicle off-street parking space provides no net increase in parking capacity if it eliminates an on-street parking space. A double off-street parking space provides a net gain of one space.

7. Increased Automobile Dependency and Use

"Minimum parking requirements act like a fertility drug for cars," describes one expert.[41] Providing abundant, free automobile parking represents a financial subsidy to automobile use worth hundreds of dollars per year, on average, per automobile.[42] The lower-density land use patterns that result from excessive road and parking standards tend to be less suitable for other travel modes.[43] Development densities under about 12 units per acre cannot effectively support public transit service and neighborhood amenities such as small shops within walking distance that substitute for driving.[44] The result of these various factors is an automobile dependent transportation system. This increases a number of transportation costs (infrastructure costs, congestion, accidents and pollution), and is particularly harmful to non-drivers since it reduces their transport options compared with more multimodal transportation and land use patterns.[45]

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[39] Todd Litman, *Parking Requirement Impacts on Housing Affordability*, VTPI (www.vtpi.org), 1999.

[40] Assuming a basic unit costs $70,000 to produce, and parking costs $10,000 per space.

[41] Donald Shoup, "The High Cost of Free Parking," *Access* No. 10 (http://socrates.berkeley.edu/~uctc), Spring 1997.

[42] Todd Litman, *Transportation Cost Analysis; Techniques, Estimates and Implications*, VTPI (www.vtpi.org), 1998.

[43] See Peter Newman and Jeff Kenworthy, *Cities and Automobile Dependency*, Gower (Aldershot), 1989. Their research further indicates that increased parking provision contributes to automobile dependency.

[44] Daniel Carlson, Lisa Wormser, and Cy Ulberg, *At Road's End: Transportation and Land Use Choices for Communities*, Island Press (Washington DC; www.islandpress.org), 1995.

[45] Todd Litman, *Costs of Automobile Dependency*, VTPI (www.vtpi.org), 1999.

Strategies to Reduce Road and Parking Demand

The following strategies can reduce the amount of land paved for roads and parking.

1. Location-Specific Standards[46]

Road and parking requirements can be reduced by using standards that reflect each site's actual needs, based on specific demand studies that take into account local geographic and demographic factors. For example, lower-priced housing with good access to services and public transit can have lower parking requirements than published standards.[47] Similarly, the number of width of traffic lanes can often be reduced.[48]

2. Trade-off Road and Parking Capacity for Transportation Demand Management

Transportation Demand Management includes various strategies to encourage more efficient travel.[49] Employers,[50] colleges and universities,[51] schools,[52] and government agencies[53] can implement travel reduction programs. If broadly implemented such programs can significantly reduce road and parking requirements.

3. Educate Decision Makers

Many decision-makers are unaware of the full cost of parking. In one survey employers estimated their parking costs at just $13 per month, although replacement and opportunity costs were many times higher.[54]

4. Develop More Efficient Development Practices and Land Use Patterns

A number of land use management strategies can reduce automobile use, and therefore the amount of land needed for roads and parking.[55] Examples of these strategies are listed in the box on the next page.

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46 *Flexible Parking Requirements*, PAS, American Planning Association (Chicago), 1983.

47 *Reducing Housing Costs by Rethinking Parking Requirements*, The San Francisco Planning and Urban Research Association (www.spur.org), 1998; Todd Litman, *Parking Requirement Impacts on Housing Affordability*, VTPI (www.vtpi.org), 1998.

48 Dan Burden and Peter Lagerwey, *Road Diets; Fixing the Big Roads*, Walkable Communities (www.walkable.org), 1999.

49 Todd Litman, *Potential TDM Strategies*, VTPI (www.vtpi.org), 1998.

50 Commuter Choice Program, Transportation Air Quality Center, USEPA (www.epa.gov/oms/traq). Philip Winters and Daniel Rudge, *Commute Alternatives Educational Outreach*, NUTI, Center for Urban Transportation Research, USF (Tampa; www.cutr.eng.usf.edu), 1995.

51 For examples visit websites for the University of Washington U-PASS program at www.washington.edu/upass, and the University of British Columbia's TREK program at www.trek.ubc.ca.

52 Safe Routes To Schools Project (www.sustrans.co.uk/srts/index.html).

53 Nancy Skinner and Stuart Cohen, *Commuting in the Greenhouse; Automobile Trip Reduction Programs for Municipal Employees*, ICLEI (www.iclei.org), 1996.

54 COMSIS, *A Survey and Analysis of Employee Responses to Employer-Sponsored Trip Reduction Incentive Programs*, California Air Resources Board (Sacramento), February 1994, p. 18.

55 Jack Faucett Associates and Sierra Research, *Granting Air Quality Credits for Land Use Measures: Policy Options*, USEPA (www.epa.gov/oms/transp), 1999.

"Smart Growth" Land Use Management Practices[56]

1. Establish a comprehensive community "vision" which individual land use and transportation decisions should support. Require that development be consistent with this strategic plan.
2. Create more self-contained communities and neighborhoods, with balanced housing, jobs and commercial development. For example, develop schools, convenience shopping and recreation facilities in neighborhoods. Mix land uses at the finest grain feasible.
3. Avoid overly-restrictive zoning. Limit undesirable impacts (noise, smells and traffic) rather than broad categories of activities. For example, allow businesses to locate in residential areas provided that they are sized and managed to avoid annoying residents.
4. Encourage cluster development. Keep clusters small and well defined, such as "urban villages" with distinct names and characters. Coordinate development to facilitate accessibility. For example, encourage employment centers near commercial centers, so employees can walk to perform errands during their breaks.
5. Encourage quality, higher density development. Eliminate unnecessary restrictions on density. Encourage high quality design that addresses concerns about density.
6. Encourage infill development. Review public costs to insure that public expenditures do not favor new, greenfield development over infill. Use variable impact fees and utility pricing that reflects the higher costs of providing public services to lower-density sites. Encourage the rehabilitate and redevelopment of older facilities and brownfields.
7. Concentrate commercial activities in compact centers or districts. Use access management to prevent arterial strip commercial development.
8. Reduce excessive and inflexible parking and road capacity requirements.
9. Develop a network of relatively direct, interconnected street. Keep streets as narrow as possible, particularly in residential areas and commercial centers. Use traffic management and traffic calming to control vehicle impacts rather than dead ends and cul de sacs.
10. Encourage shared parking facilities and parking management strategies.
11. Design streets to accommodate walking and cycling. Create a maximum number of connections for non-motorized travel, such as trails that link dead-end streets.
12. Create pedestrian- and transit-friendly commercial centers.
13. Use transportation demand management strategies to reduce total vehicle traffic.
14. Preserve open space, particularly areas with high ecological and recreational value. Channel development into areas that are already disturbed.
15. Use on-site stormwater drainage systems.
16. Place higher density housing near commercial centers, transit lines and parks.
17. Encourage a mix of housing types and prices. Develop affordable housing near employment, commercial and transport centers. Develop second suites, apartments over shops, lofts, location-efficient mortgages and other innovations that help create more affordable housing.

[56] Reid Ewing, *Best Development Practices*, Planners Press (Chicago; www.planning.org), 1996.

5. Share Parking[57]
Assigning automobile commuters or residents of multi-family housing to a group of spaces (a "zone") rather than an individual space typically allows 15-25% additional users, since some vehicles are away at any particular time. Mixed land use allows parking supply reductions since some uses, such as office centers, have weekday peaks, while others, such as dining, and recreation centers, have evening and weekend peaks. This typically allows a 30-50% reduction in parking requirements. Flexible zoning laws allow firms to trade parking capacity among themselves to optimize use. Some local governments allow developers to pay "in lieu" fees instead of providing on-site parking.[58] Revenues are used to provide public parking facilities, which tend to be more cost effective due to sharing, economies of scale, and more flexibility design.

6. Unbundle Parking
Parking facilities are often "bundled" with buildings, which means that a certain number of spaces are included with building purchases or leases. This assumes that all users have the same and unchangable parking requirements. It is more fair and efficient to sell or rent parking separately, so building users pay for just the number of spaces that they require, and can adjust their parking supply as their needs change.

7. Establish Transportation Management Associations (TMAs)
TMAs coordinate transport activities at the worksite, neighborhood or municipal level, which is more effective than smaller, individual programs managed by individual employers.[59] Such programs distribute information, organize transportation fairs, perform ride matching, manage parking, sponsor guaranteed ride home services, and help plan transit, bicycle and pedestrian improvements, site amenities, and other TDM policies.

8. Establish Maximum Rather Than Minimum Parking Standards
As part of their overall TDM plan, some communities have established upper limits as to the number of parking spaces that are allowed at individual sites or in a zone.[60] This is usually applied in commercial centers with high quality transit and other features that minimize automobile travel. Imposing a parking limit encourages better utilization of existing facilities, forces businesses to encourage their employees and customers to use alternative travel modes, and allows more parking to be priced.

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[57] Barton-Aschman Associates, *Shared Parking*, Urban Land Institute (www.uli.org), 1982.
[58] Donald C. Shoup, "In Lieu of Required Parking," *Journal of Planning Education and Research*, Vol. 18, 1999, pp. 307-320.
[59] Erik Ferguson, Catherine Ross and Michael Meyer, "Transportation Management Associations: Organization, Implementation, and Evaluation," *Transportation Research Record 1346*, 1992, pp. 36-43; Lori Diggins and Eric Schreffler, "Status Report on Transportation Management Association Development in California," *Transportation Research Record 1346*, 1992, pp. 53-61.
[60] K.T. Analytics, Inc., *Parking Management Strategies: A Handbook For Implementation*, Regional Transportation Authority (Chicago), 1995, p. 28.

9. Charge for Parking/Cash Out Free Parking

The simplest way to reduce parking demand is to charge users directly for facility costs. Charging employees for parking typically reduces solo commuting by 20-40%, indicating an elasticity of -0.16.[61] Other studies show even greater price sensitivity.[62] An EPA study indicates that a $1.37-2.73 increase in parking fees reduces auto commuting 12-39%, and if matched with transit and rideshare subsidies, reduces total auto trips by 19-31%.[63]

However, charging for parking may be politically difficult, since free parking has become so common. An alternative is to cash-out free parking. This means that commuters who don't drive receive the cash equivalent of their parking subsidy.[64] This tends to reduce automobile commuting by 10-40%, and increases equity by giving non-drivers a benefit comparable to what automobile commuters receive. Since parking is tax deductible but cash pays are not, it can also increase tax revenue.

10. Use Better Parking Charging Technologies

Paying for parking is currently difficult, since it often requires having specific types of coins, and users must predict how long they will be parked. New pricing technologies reduce these transaction costs.[65] Some systems allow users to pay for parking using bills or credit cards. Others use a small meter displayed inside the vehicle which counts off credits while it is parked, so drivers pay for just the amount of parking they actually use.[66]

11. Shorter-Term Pricing

Parking, when it is not free, is often rented by the month, and long-term renters receive bulk discounts. It is more efficient to rent parking on a daily basis, or to give a discount on monthly leases for days not driven. For example, if full-time parking costs $50 per month, commuters should be able to pay $30 if they agree to only drive 3 days per week. This gives commuters a financial incentive to use alternative modes when possible.

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[61] Donald Shoup, "Employer-Paid Parking," *Transportation Quarterly*, Apr. 1992, Vol. 46, No. 2, p. 172.

[62] John Shaw, *Planning For Parking*, Public Policy Center, University of Iowa (Iowa City), 1997, p. 24; GoPlan, *Price Effects of Demand and Supply Changes for Downtown Parking*, City of Calgary, Jan. 1995.

[63] ICF, *Opportunities to Improve Air Quality Through Transportation Pricing*, Office of Mobile Sources, EPA (Washington DC; www.epa.gov/omswww/market), 1997, Table 3-1.

[64] *Local Government Guide to Parking Cash Out*, International Council for Local Environmental Initiatives, (www.iclei.org/us), 1998; Donald Shoup, "Congress Okays Cash Out," *Access*, No. 13, UCTC (http://socrates.berkeley.edu/~uctc), Fall 1998, pp. 2-8.

[65] James Luk, *Technologies for On-Street Paid Parking*, Australia Road Research Board, 1995.

[66] K.T. Analytics, Inc., *Parking Management Strategies: A Handbook For Implementation*, Regional Transportation Authority (Chicago), 1995.

12. Parking Benefit Districts
There are many ways to deal with spillover parking problems. Residential neighborhoods could create a "Parking Benefit District," where on-street parking is charged (at least for non-residents) with revenues used for neighborhood enhancement or to reduce property taxes.[67] Resident's vehicles can be exempted from these charges.

13. Implement Access Management[68]
Access management involves a number of specific road design, land use management, and transportation management strategies to reduce the number of driveways and intersections on arterials and highways, and improve pedestrian access. This tends to increase safety and mobility on existing roadways, better accommodate alternative transportation modes, and reduce the demand for new highways.

14. Neotraditional Neighborhoods[69]
Neotraditional neighborhood design emphasizes small-scale blocks, an interconnected street network, good pedestrian and bicycle facilities, and moderate to high density mixed land use. Road requirements tend to be significantly lower than with conventional street design. For example, narrow 25-foot curb-to-curb street widths are common, although this reduction may be partly offset by additional sidewalks and alleys. Residents in such neighborhoods have significantly fewer automobile trips than people living in automobile dependent areas. Neotraditional planning also tends to have less pavement per capita.

15. Transportation-Efficient Development and Location-Efficient Mortgages
Transportation-efficient housing is located to be accessible to common services (shops, schools, etc.), jobs and transit service.[70] This allows households to reduce their automobile ownership expenses. Location-efficient mortgages mean that these household transportation cost savings are considered by lenders when assessing mortgages, which gives home-buyers an added incentive to choose location-efficient residences.[71]

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[67] Donald Shoup, "An Opportunity to Reduce Minimum Parking Requirements," *Journal of the American Planning Association*, Vol. 61, No. 1, Winter 1995, pp. 14-28; Lawrence Solomon, "On the Street Where You Park: Privatizing Residential Street Parking," *The Next City*, Vol. 1, No. 2, Winter 1995, pp. 58-61.
[68] Elizabeth Humstone and Julie Campoli, "Access Management," *Planning Commission Journal* (www.webcom.com/~pcj/access/accintro.html), 1996; *Access Management Manual*, Colorado DOT (www.dot.state.co.us/business/accessmgt/ACCESS/Newbib2.htm), 1998.
[69] Transportation Planning Council Committee, *Traditional Neighborhood Development; Street Design Guidelines*, Institute of Transportation Engineers (Washington DC; www.ite.org), 1997.
[70] Patrick Hare, *Planning, Transportation and the Home Economics of Reduced Car Ownership: Planning as if Household Budgets Mattered*, Hare Planning (Washington DC), 1995.
[71] Kim Hoeveler, "Accessibility vs. Mobility: The Location Efficient Mortgage," *Public Investment*, American Planning Asso. (Chicago; www.planning.org) and Center for Neighborhood Technology (www.cnt.org/lem), 1997; Fannie Mae (www.fanniemae.com); David B. Goldstein, *Making Housing More Affordable Correcting Misplaced Incentives in the Lending System*, NRDC (www.nrdc.org), 1996.

16. Car-Free Housing[72]

Car-free housing is specifically located and designed for households that do not own an automobile. They are typically in highly accessible locations (with good transit and commercial services within easy walking distance), and some have integrated carsharing services to allow residents to use an automobile when needed without owning one.

17. Develop Overflow Parking Plans

Excessive parking is sometimes required to meet peak parking demands that occurs infrequently, during special events. Instead, regular parking may be reduced if facility managers develop an overflow parking management plan, that makes use of off-site parking, perhaps with shuttle-bus service, or other special-use parking facilities.

18. Allow In Lieu Fees As An Alternative To On-Site Parking[73]

In lieu fees allow developers to fund off-site municipal parking facilities instead of providing on-site parking, usually at the developer's discretion. This gives developers more flexibility (allowing better site design and preservation of unique and historic resources that cannot otherwise accommodate on-site parking), allows parking facilities to be located where they most optimal for the sake of urban design, and results in more efficient and cost effective shared parking facilities.

19. Environmentally Sensitive Facility Design[74]

In addition to reducing the amount of land paved for roads and parking, a number of design features can reduce the environmental impacts of such facilities:

- On-site stormwater storage and percolation, with natural wetlands for filtering.
- Maximum greenspace, particularly shade trees.
- Attention to aesthetics.[75]
- Paving materials that allow water to percolate and grass to grow (see photo below).[76]

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72 Jan Scheurer, "Car-Free Housing in European Cities; A New Approach to Sustainable Residential Development," *World Transport Policy and Practice* Vol. 4, No 3, (http://wwwistp.murdoch.edu.au/research/carfree.html), 1998.

73 Donald C. Shoup, "In Lieu of Required Parking," *Journal of Planning Education and Research*, Vol. 18, 1999, pp. 307-320.

74 Mark Childs, *Parking Spaces; A Design, Implementation, and Use Manual for Architects, Planners, and Engineers*, McGraw Hill (www.booksite.com), 1998.

75 *The Aesthetics of Parking*, PAS, American Planning Association (Chicago; www.planning.org) 1988.

76 These products are widely advertised in *Landscape Architecture* and similar magazines. An example is the Turfstone by Westcon (www.westconpavers.com) which has 50% open space.

Summary

There are many reasons for minimizing the amount of land paved for roads and parking. Paving leaves less land available for other productive uses, and reduces the tax base. Pavement increases stormwater management and energy costs. Free parking represents a subsidy that encourages driving, contradicting transportation demand management objectives. Excessive road and parking requirements encourage urban sprawl and create land use patterns that are unsuitable for other modes. This is inequitable, favoring people who drive more than average over those who drive less than average. Excessive pavement displaces greenspace, making the landscape unattractive and ecologically barren.

Current policies result in excessive pavement. Zoning laws oversupply parking and roadway capacity, and transportation policies favor automobile travel over other modes. Planners who implement these standards tend to focus on convenience to motorists and administrative simplicity, and underweigh other objectives. As a result, they tend to err toward oversupply of parking and road capacity.

There are many ways to reduce parking and roadway requirements through better management practices. These strategies are technically feasible and can provide overall benefits to communities. The main barriers to implementing these strategies are institutional. Policy makers and planners are accustomed to solving problems by adding infrastructure capacity. It is time to focus on using existing capacity more efficiently.

Soviet-Style Central Planning

The Soviet Union collapsed partly because of its inefficient, centrally-planned economy. For example, planners gave priority to bread production, making it very cheap. This made sense, since bread is an important staple. But low prices lead to excessive consumption, resulting in continued bread shortages. A central planner looking at long lines of consumers waiting at bakeries would conclude that even more bread production is needed.

This was inefficient, and unsatisfactory to consumers. A rational economy lets production and prices be determined by market supply and demand. Consumers are charged the true cost of the goods they purchase. As bread subsidies decreased, Russian consumers ate a more balanced diet. They are actually better off overall with a competitive market economy.

Conventional parking requirements are equivalent to Soviet-style central planning. Certainly, mobility is important, automobiles are the dominant form of mobility, and automobiles require parking, so it seems sensible to simply require abundant parking at every building. But this is actually inefficient and unfair. It is far better to charge motorists directly, rather than indirectly, for the costs of their parking, to test whether they really want to drive for a particular trip.

Of course, it is not possible to change instantly from abundant, free parking to full-cost, market based parking. This requires institutional changes, methods to minimize transaction costs, and improved travel choices. But it is clear what type of change will lead to more efficient transport and land use patterns: moving away from rigid, central planning and incrementally toward a competitive market for parking facilities and other transportation services.

Resources

Dan Burden, *Street Design Guidelines for Healthy Neighborhoods*, Center for Livable Communities (Sacramento; www.lgc.org/clc), 1998.

Dan Burden and Peter Lagerway, *Road Diets Free Millions for New Investment*, Walkable Communities (www.walkable.org), 1999.

Stephen Burrington & Veronika Thiebach, *Take Back Your Streets; How to Protect Communities from Asphalt and Traffic*, Conservation Law Foundation (Boston; www.clf.org), 1995.

Center for Livable Communities (www.lgc.org/clc) helps local governments and community leaders be proactive in their land use and transportation planning.

Center for Urban Transportation Research, USF (Tampa; http://cutr.eng.usf.edu) provides TDM materials and classes, and publishes *TMA Clearinghouse Quarterly*.

Center for Watershed Protection (www.cwp.org) provides analysis and resources for minimizing hydrologic impacts and pollution.

Commuter Choice Program, Transportation Air Quality Center (www.epa.gov/oms/traq).

Congress for the New Urbanism Narrow Streets database (www.sonic.net/abcaia/narrow.htm).

David Engwicht, *Street Reclaiming; Creating Livable Streets and Vibrant Communities*, New Society Publishers (www.newsociety.com), 1999.

Reid Ewing, *Best Development Practices; Doing the Right Thing and Making Money at the Same Time*, Planners Press (Chicago; www.planning.org), 1996.

Wolfgang Homburger, *Residential Street Design and Traffic Control*, Institute of Transportation Engineers (Washington DC; www.ite.org), 1989.

Michael Kodama, et al., *Using Demand-Based Parking Strategies to Meet Community Goals*, South Coast Air Quality Management District (Los Angeles), 1996.

K.T. Analytics, Inc., *Parking Management Strategies: A Handbook For Implementation*, Regional Transportation Authority (Chicago), 1995.

Todd Litman, *Parking Requirement Impacts on Housing Affordability*, Victoria Transport Policy Institute (Victoria; www.vtpi.org), 1996.

Local Government Parking Policy and Commute Trip Reduction; 1999 Review, Commute Trip Reduction Office, WSDOT (Olympia, www.wsdot.wa.gov/pubtran/ctr), 1999.

NEMO Project (www.canr.uconn.edu/ces/nemo) addresses impervious surface impacts.

The San Francisco Planning and Urban Research Association (www.spur.org).

Donald Shoup, "An Opportunity to Reduce Minimum Parking Requirements," *Journal of the American Planning Association*, Vol. 61, No. 1, Winter 1995, pp. 14-28.

The Smart Growth Network (www.smartgrowth.org) includes planners, govt. officials, lenders, community developers, architects, environmentalists and activists.

Sprawl Watch Clearinghouse (www.sprawlwatch.org) provides information on land use issues.

Washington State DOT Northwest Technology Transfer Center (Olympia; www.wsdot.wa.gov/TA/T2/publications.html) offers TDM planning and evaluation resources.

Here are related reports available from VTPI:

The Costs of Automobile Dependency

First Resort; Application of TDM in Resort Communities

Generated Traffic; Implications for Transport Planning

Land Use Impact Costs of Transportation

Potential TDM Strategies

Traffic Calming Benefits, Costs and Equity Impacts

Transportation Cost Analysis for Sustainability

Win-Win Transportation Management Strategies

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The Victoria Transport Policy Institute appreciates feedback, particularly suggestions for improving our products. After you have finished reading this report please let us know of any:

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Thank you very much for your help.

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